

10-11-00
12.3.8 v-7

Memo

To: Mike Hrizuk, Craig Puljan, Dick Johnson, Gary Wright, Henrik Voldbaek

Copy: Aaron Conger, Mike Burrup, Montana City Process Engineer, Jim Nelson, Seattle Process Engineer

From: Hans E. Steuch

Date: October 11, 2000

Re: AGPEP Power Audit Report

The subject report is attached. The highlights of the report were presented by your plant process engineer to his peers at the July 2000 Annual AGPEP Meeting and by Ron Videgar and me to the plant managers at the September 2000 Annual Plant Manager's Meeting.

Thank you for all assistance in the audit and preparation of the report. Hopefully it will be a useful reference.

Hans

*CA/CM.
10/17/00*

*Please review/return
copy if you like.*

*me
10/17/00*

USEPA SF



1274667

**Ash Grove Cement Company
Seattle Plant**

**AGPEP Power Audit
April, 2000**

*August 25, 2000
HES*

| Subject | Page |
|--|-------------|
| Executive Summary..... | 3 |
| Introduction..... | 4 |
| Compressed Air Systems..... | 4 |
| Electrical Systems..... | 5 |
| Recommendations..... | 6 |
| Appendix A - Plant Air System..... | 7 |
| Appendix B - Electrical Motors..... | 22 |
| Appendix C - Audit Schedule and Task List..... | 35 |

Executive Summary

The focus of the Process Excellence Program during the year 2000 is plant utilities, namely, compressed air and electrical power consumption. Seattle's average electrical power costs have been 8 percent of the total plant operating costs in recent years. The audit reported here determined that electrical power consumption for the production of compressed air is 3 percent of Seattle's power usage and amounts to approximately 13 cents per ton of cement.

The compressed air system supply side is composed of three Quincy Northwest air compressors with inlet throttle controls. Two machines are used at any given time to produce plant air, while the other machine is down for maintenance. Rotation keeps all compressors equally well maintained. Of the two running, one is usually 100 percent loaded, while the other is about 60 percent loaded. Plant air is supplied at 90-100 psig to the main air receiver.

The demand side is composed of typical items requiring air in a cement manufacturing facility: jet pulse dust collectors, air blasters, air vibrators, air lances, cooling for cameras, air rams for gates.

We compared the theoretical demand by plant equipment for compressed and dried air with what was actually being produced by the three main plant air compressors and got very close agreement.

Leak seeking was conducted on about half of the demand side and 33 leaks of various sizes were detected. The leaks came from fittings, unions, solenoids and the like. If all leaks were stopped, the reduction in compressed air usage should result in annual power savings of 3,000 dollars.

The specific power consumption of the Seattle plant has been the lowest among Ash Grove's dry process facilities until 1998, where the Durkee expansion made that plant the lowest. During the plant audit, we found little equipment running needlessly. All major process fans are being operated with dampers open. Plant personnel acknowledged that occasionally belts and other equipment run when they do not need to. Ongoing process control and interlock programming efforts aim, among other things, to minimize wasteful idling.

Introduction

On April 4 to 6, 2000, Mike Dwyer, Doug Lux and the writer conducted a power audit on the Seattle plant. The format, how it has evolved, as well as the objective for this audit, is described in detail in the documents distributed by Ron and the writer in the first quarter of this year^{1, 2, 3}.

We spent the first day and a half studying the plant's use of compressed air and the remaining day and a half reviewing and summarizing the plant's motors and their uses, all the while looking for opportunities to save power. The attached audit task list guided our activities.

Compressed Air Systems

The plant has one main compressed air system serving the entire plant and some smaller systems serving specific needs for compressed air in limited areas of the plant.

The plant's main air compressors are two Quincy NW 740-C and one Quincy NW 740-E. They are centrally located under the preheater tower. 200 HP motors drive them all. The compressed air passes through an oil separator and cooler which is an integral part of the Quincys. From the cooler, the compressed air goes to a desiccant, pressure swing regenerative type dryer and final filtering before entering the receiver tank from which the air flows to the demand side of the system.

We clamped a digital power-meter on the 200 HP motor of the make-up compressor, familiarized ourselves with the compressors, tested the supply side equipment for leaks, and studied the attached power-meter data of compressor conditions. Thereafter we followed the branches of the demand side piping to as many of the end points as time permitted. Under way,

¹ Memo of 2/08/00 by Ron Videgar to plant managers regarding PEP 2000 Program .

² Memo of 2/28/00 by Ron Videgar to process engineers regarding PEP 2000 Program. Contains copies of Compressed Air and Gas Handbook Tables and of Ingersoll-Rand's web site documents.

³ Memo of 3/13/00 by Hans E. Steuch to Western Region process engineers containing suggestions for compressed air audit preparation.

we tried to find compressed air leaks by listening for them and by watching the indicator on Seattle's portable ultrasonic leak finding device⁴.

The collected and calculated information is shown in the attachments. They indicate that:

- about 7 percent of the actual demand is caused by leaks;
- the demand varies over hours and days in a relatively narrow band around 80 percent of the Quincy compressor capacity;
- the estimated actual annual average power cost for making plant air is \$0.13/ton cement;
- the potential annual cost at Seattle of a ¼" diameter leak that is left unattended is \$4,457.

Ten smaller plant air compressors serving specific areas and needs are spread around the plant. The motors on these ten compressors add up to 177 HP. These compressors were not studied in detail.

As in most of our plants, replacing the pneumatic conveying of cement from grinding to storage with mechanical conveying could save some power. The payback generally exceeds ten years and was not addressed for Seattle during this audit.

Electrical Systems

The review of electrical systems centered on development and study of a motor list in electronic format. The Instrument/Electrical Supervisor currently keeps motor information in an Access database. Key information was transferred from this database to an Excel workbook. This allowed sorting of the motors according to department, use, type of conveyor driven by the motor and so on. In addition to motor data, the workbook contains columns related to design details of the equipment driven by the motor, whether a conveyor, part of a Fuller-Kinyon system, or a fan. Information from other sources in the plant can be transferred to these columns

⁴ UE Systems, model UE2000.

for future reference; however, this work was not started and it is intended that plant personnel will complete the data entry as time permits. The attachments show the key motor information.

Major fans in the plant were studied in the field to assess whether they could be operated in a more energy efficient manner.

The work and observations led to the following conclusions:

- we did not find any obvious areas for power saving;
- the motor tally indicates Seattle has a total of about 22,400 connected motor horsepower, making the potential annual average specific power consumption 159 kWh/ton cement; the actual annual specific power consumption has been in the 113 to 114 kWh/ton range in recent years;
- of the connected horsepower, the largest contribution comes from the clinker grinding department (34%) and the next largest from the raw grinding department (18%).

Recommendations

None.

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Attachment A
Plant Air System

Plant Air Costs

The total potential annual power cost of providing compressed air for general plant use =
(combined HP rating of all plant air compressors)
*(factor for converting from HP to kW)
*(potential number of hours operated in a year)
*(cost per kWh)
/(motor efficiency).

The plant's main air compressors are two Quincy NW 740-C and one 740-E. They all are driven by 200 HP motors. In addition, there are smaller plant air compressors serving specific areas and needs spread around the plant. Following the material flow through the plant, there is one 3 HP compressor for instrument air in the preheater tower, one 75 HP compressor for the preheater downcomer spray, one 2 HP compressor for the flop gates on top of the clinker silos, two 30 HP compressors for the high efficiency dust collectors on the finish mills, one 15 HP compressor in the storage dome tunnel, one 2 HP compressor for the steel scale tanks and one 20 HP compressor for the east packhouse. The motors on these eleven compressors add up to 777 HP.

$$\frac{(777 \text{ HP}) * (0.746 \text{ kW/HP}) * (8,760 \text{ potential hrs/yr}) * (0.030 \text{ \$/kWh})}{0.85 \text{ assumed efficiency}}$$

$$= \$179,212 \text{ total potential annual cost or } \$0.23/\text{ton cement}^1$$

Typically the compressors are not operated at full capacity all the time. Only two of the three 200 HP compressors can operate at any given time. Our measurements on 4/3-4/4/00 show that one is operated at full capacity while the other typically is at 60 %. Spot checks on the two 30 HP compressors showed one operating at 100 % capacity and the other at 60 % capacity. The east packhouse compressor is not used any more, even if it is still connected. If we assume all the other compressors operate at 60 % capacity, the typical load, therefore, is:

$$(200 \text{ HP}) * 0\% + (200 \text{ HP}) * 100\% + (200 \text{ HP}) * 60\% + (3+75+2 \text{ HP}) * 60\% + (30 \text{ HP}) * 100\% + (30 \text{ HP}) * 60\% + (15+2) * 60\% + (20 * 0\%)$$

$$= 426 \text{ HP, corresponding to}$$

$$\frac{(426 \text{ HP}) * (0.746 \text{ kW/HP}) * 24 \text{ hrs/day}}{(2,400 \text{ tpd clinker}) * (0.942 \text{ t cement/t clinker})^2}$$

$$= 3.0 \text{ kwh/st cement, which is}$$

$$(3.0 \text{ kwh/st cement, for plant air}) / (113.5 \text{ kwh/st clinker, total annual average}) * 100$$

¹ Assuming an annual cement production capacity of 784,000 tons. From CTW's 2000 Plant Capacity Summary.

² CTW's 2000 Plant Capacity Summary

= 3 % of the total annual average specific power consumption per ton of cement

and the power cost is

$$\frac{(426 \text{ HP}) * (0.746 \text{ kW/HP}) * (8,760 \text{ potential hours/yr}) * (0.030 \text{ \$/kWh})}{0.85 \text{ assumed efficiency}}$$

= \$98,225 typical potential annual cost or \$0.13/ton cement

The actual annual cost is a little lower than this and dependent upon how much the air demand drops when the plant goes down.

Determination of Miscellaneous Compressed Air Demands

Air Dryers: The purge air requirements of the twin-tower regenerative type of air dryer in use at Durkee can range from 10 to 18 percent of total air flow. For this study we used 14 percent.

Air Cannons: At the Inkom plant, the raw material silos contain half a dozen medium sized air cannons that are PLC controlled. Eyeballing their dimensions coupled with Mike Burrup's remarks that one goes off every few minutes coupled with study of the blaster maintenance manual, made us guess their compressed air usage is 25 cfm. This number has been used for Seattle also.

Jet-Pulse Dust Collectors: Jet-pulse dust collectors at Seattle generally have 1.5 inch pulse valves that operate 100 milliseconds with a feed pressure of around 90 psig. According to BHA³ this means they require 4.2 cubic feet of dry compressed air per pulse. The compressed air usage per minute (in cfm) for a given jet pulse dust collector, therefore, can be calculated as the number of pulses per minute times 4.2.

Fuller Kinyon Pump Seal: At Inkom the seals for the FK pumps in the mill room are supplied air at 25 psig and exhaust through 1/8" holes requiring a total³⁾ of 18 cfm. This number has not been applied at Seattle, as clinker grinding and shipping FK pumps are serviced by small compressors dedicated to these departments and therefore are not using general plant air.

Herzog Sampling Transport System: It uses plant compressed air to convey a roller mill sample every hour to hour and a half and a kiln feed sample every two hours. If we assume the conveying line is 4 inches in diameter and 200 feet long, the line air to displace for every conveyance is 17.5 cubic feet. Assume further that line losses require a doubling of that quantity. Then the estimated average compressed air requirement becomes $2 * (17.5 \text{ cf/sample}) * (3 \text{ samples/120 minutes}) = 1 \text{ cfm}$.

PF Bin Aeration System: This system contains numerous valves that activate 2 seconds ever so often. We guessed the system uses 10 cfm. The actual nozzle pressure, number of nozzles, their orifice size and time of operation would have to be known to refine this guess.

³ BHA memo from Gregg Zoltek of July 3, 1997

Powdered Material Samplers: There are a couple of these samplers in use. The dimensions of the samplers are about 2 inches in diameter times 10 inches long, giving an internal volume of 0.02 cubic feet. If they operate every five minutes or so, the compressed air requirements are negligible.

Quadtek Camera: The Inkom Quadtek manual informs that the lens tube requires about 20 cfm which enters into the kiln hood and up to 30 cfm for cooling the camera housing. For Seattle's one camera we assumed the total is 30 cfm.

Raw Mill Water Spray: Seattle's raw mill water sprays have been assumed to require 50 cfm, corresponding to a 1/4" orifice at 40 psig. The actual nozzle pressure, number of nozzles, their orifice size and time of operation would have to be known to refine this guess.

Reverse Air Dust Collectors: The amount of compressed air required to move the isolation gate actuators has been considered insignificant (similar to the powdered material samplers).

Vibrators: At Inkom there are vibrators on all raw material silos and on the hoppers of the electrostatic precipitators. A total of thirteen vibrators were counted. A mercury switch or timer generally activates them. When they operate, air at 90 psig passes through a 1/4" hole exhausting³⁾ 95 cfm per hole and giving a potential usage of $13 \times 95 \text{ cfm} = 1,235 \text{ cfm}$. We assumed they only operate 1 % of the time, drawing an average of 12 cfm. There are some vibrators scattered around the Seattle plant, but this intelligence has not been applied for Seattle.

Whole Tire Feed System: Although relatively large, the pneumatic cylinders use a negligible amount of compressed air, according to the calculation done for the powdered material samplers.

Theoretical vs. Actual Demand

The compressed air demand Fuller calculated in 1991 (dwng. # 135-90-2436) indicates the theoretical demand for which the main plant compressed air system was designed was 850 cfm. Since 1991 the following demand has been added to that system: Powdered material samplers and Herzog sampling transport system (1 cfm), Blasters (50 cfm), Whole tire feed system (0 cfm), Quadtek Camera (30 cfm), Raw Mill Water Spray (50 cfm), PF Bin Aeration System (10 cfm) which increases the theoretical demand to 991 cfm.

The actual demand is the air supplied by the compressors after drying. We found the capacity usage indicated on the compressors to be 100% of 740 on one, 60% of 740 on the other, for a total of 1,184 cfm. The dryer uses about 14 percent of this for purge air, leaving 1,018 cfm.

The theoretical demand constituted $(991 \text{ cfm}) / (1,018 \text{ cfm}) \times 100 = 97 \%$ of the actual demand.

Potential Savings from Closing all Leaks

The difference between the actual and theoretical demand is $1018 - 991 = 27$ cfm. We can call this "unaccounted demand". It is 3 percent of the actual demand reported by the manometers on the compressors, well within the accuracy of these calculations.

The leak survey tabulated below indicates we found 23 small and 10 large leaks. We only had time to survey some of the plant. The leaks were found in portions of the compressed air system representing 376 cfm, or 44 percent of the original design demand of 850 cfm. If we assume that the leak density is the same over the entire system, there must be $23/376 * 850 = 52$ small and $10/376 * 850 = 23$ large leaks in the entire system.

If we further assume that a large leak allows 3 cfm to escape, while a small one only lets 0.03 cfm out, the total estimated leakage would be $52 * 0.03 + 23 * 3 = 71$ cfm, which is more than the unaccounted demand calculated above.

The leakage of 71 cfm mentioned above requires⁴ about 14 HP which, according to the formulas above, represent

$$\frac{(14 \text{ HP}) * (0.746 \text{ kW/HP}) * (8,760 \text{ hours/yr}) * (\$0.030/\text{kWh})}{0.85 \text{ assumed motor efficiency}}$$

$$= \$3,229 \text{ potential annual savings if all leaks were closed.}$$

This calculation, however, is rather speculative, due to assumptions made and general accuracy of the estimate of the unaccounted demand.

Cost of a Quarter Inch (1/4") Leak at Seattle

The demand side, where most leaks occur, operates around 90-95 psig at Seattle. At this pressure a 1/4 inch leak will discharge⁵ 98 cfm. According to the calculations above, this could cost $(\$3,229/71 \text{ cfm}) * (98 \text{ cfm})$

$$= \$4,457 \text{ potential annual cost to leave a 1/4" leak unclosed.}$$

⁴ Seattle City Light report of December, 1998: $0.152 \text{ kWh/cfm} \cong 5 \text{ cfm/HP-hr}$

⁵ Compressed Air and Gas Handbook, Third Edition, 1961, LOCCN 60-16722, Table 8.34.

**Attachment A
Plant Air System**

Plant Compressed Air System Leaks

| Ash Grove Cement Company, Seattle Plant | | | | | | |
|--|---------------------|---------------------|-----------------|-----------|----------------------|--|
| Survey of Plant Compressed Air Leakage April, 2000 | | | | | | |
| Area (1) | Normal Flow cfm (1) | Service Air cfm (1) | Small Leaks (2) | # | Large Leaks (3) | # Added since (1) |
| Tower #5 | 39.6 | | | | | |
| Tower #6 | 30.5 | | | | | |
| Raw Coal Bin | 15 | | | | | (Dalamatix inefficient; disable) |
| Coal Mills | 112.6 | 50 | h, i, j, g, k | 4 | | |
| Tower #8 | 20.4 | | | | | |
| Dump Building | 22.2 | 50 | | | | |
| Silo Roof | 66.1 | | | | | |
| Silo Mid | 21.6 | 50 | | | | |
| Kiln Feed | 44.7 | 50 | b, c, d | 3 | a | 1 Herzog, Samplers |
| Preheater | 54.3 | 530 | u, v, w, y, ee | 5 | x, z, aa, bb, cc, dd | 6 Blasters, Whole Tire Feed System |
| Kiln Discharge | 81.7 | | | | | |
| Burner Floor | 0.2 | 50 | | | | Quadtek, Air Cannon |
| Silo Grade | 2.8 | | | | | |
| C.C. Building | 1.0 | | | | | |
| Tower #7 | 18 | | | | | |
| Raw Mill | 0 | 50 | e, f, g | 3 | | Water Spray |
| P.F. Bins | 52.7 | | ff, gg | 2 | | Bin Aeration System |
| Finish Mill | 50 | 50 | l, m, n, hh, ii | 5 | jj | 1 Compressors, Separators, Baghouses, Insitecs |
| Tower #1 | 20 | | | | | |
| RM Bins | 60.8 | 50 | R | 1 | | |
| Tower #2 | 19.5 | | | | | |
| Tower #11 | 0.5 | | | | | |
| Tower #3 & #4 | 19.5 | | | | | |
| Clinker Silo | 27.0 | | | | s, t | 2 |
| RM Baghouse | 15.0 | 50 | | | | |
| Maintenance Building | 0 | 50 | | | | |
| G-Cooler | 52.5 | 50 | | | | |
| Totals | 848 | 1,080 | | 23 | | 10 |
| Notes: | | | | | | |
| (1) on Fuller drawing 135-90-4-2436 rev.2, 9-30-91 | | | | | | |
| (2) found with Ultrasonic Leak Finder, can't be heard, can't be felt with hand | | | | | | |
| (3) can be heard and sometimes felt | | | | | | |
| a) fitting(s) on solenoid for kiln feed sampler | | | | | | |
| b) fitting(s) on solenoid for east kiln feed shut off gate | | | | | | |
| c) fitting(s) on solenoid for west kiln feed shut off gate | | | | | | |
| d) fitting(s) on solenoid for kiln feed dust collector discharge flopgate | | | | | | |
| e) valve, 1", on E side of 2nd floor | | | | | | |
| f) union, 1", near control box above silo 5 | | | | | | |
| g) oiler in 3/4" line on E side of silo pack | | | | | | |
| h) valve, 1", on S side of 3rd level | | | | | | |

Attachment A
Plant Air System

| | |
|--|--|
| e) hose, 1" diameter with quarter turn open valve, in roller mill cyclone airslide | v) fittings on solenoid for actuator for kiln feed to 3rd stage riser |
| f) union, 2" diameter, on conveyor to RM triple gate | w) 1" shut off valve on S side of 6th level |
| g) fitting on regulator on RM body spray | x) fittings on regulator for downcomer analyzer, SW corner of 6th floor |
| h) fitting on regulator for coal mill isolation damper | y) oiler for air blaster on 5th stage cone W side |
| i) fitting(s) on solenoid for coal mill sampler | z) solenoid/actuator for lower tire chute gate |
| j) union, 1" diameter(?), under N side of dust collectors | aa) filters on SE side of upper part of calciner |
| k) union, 2" diameter(?) on E side of coal mill building along wall to MCC | bb) fittings on gas analyzer receiver on kiln feed hood |
| l) fittings on air dryer of East cement mill Quincy compressor | cc) union in 3/8" charge line to N air cannon on kiln feed hood |
| m) filter on Insitac supply line | dd) main valve on large S air cannon on kiln feed hood |
| n) ? by clinker feeders | ee) regulators on natural gas valve train |
| o) union at entrance to burner tunnel | ff) fittings for shut off gates under pulverized coal bin |
| p) fitting(s) on solenoid at coal shut off gate in burner tunnel | gg) fittings for shut off gates and blow back valves above Pfister feeders |
| q) union in 2" pipe on N side of burner tunnel | hh) regulator on NE d.c. in clinker tripper galley |
| r) valve, 1", on E side of 2 nd floor | ii) regulator and Goyen valve on NW d.c. in clinker tripper galley |
| s) union, 1", near control box above silo 5 | jj) Goyen valve in SW d.c. in clinker tripper galley |

Estimate of Compressed Air Leaks Worth Fixing

What size leak is it economically justified to repair? The answer could be: "the one where the expense of repairing it is paid back in power savings in less than two years". This can be expressed as follows:

$$X > TF * RC / (PU * PC * \$25,600 * DP).$$

For example:

| Input | Symbol | Value | Units | Sources |
|----------------------------|--------|-------|--------|---------------------------------|
| Size of leak | X | 0.004 | cfm | Formula above |
| Time to fix leak | TF | 1 | hour | HES guess |
| Repair manpower cost | RC | 20 | \$/hr | HES guess |
| Power use | PU | 0.152 | kW/cfm | City of Seattle 12/23/98 Report |
| Cost of power | PC | 0.033 | \$/kW | City of Seattle 12/23/98 Report |
| Longest acceptable payback | DP | 2 | years | Ash Grove CAPEX Standard |

The calculations show it is worthwhile to fix leaks that release as little as 0.004 cfm. Tests done later at Montana City indicated small leaks detected with the ultrasonic sound measuring devices are an order of magnitude larger than this. In other words, any leak that can be detected with an ultrasonic device is worth fixing.

204 CFM

22 2 CFM (NORMAL)
22 2 CFM (INTERMITTENT)

90

2" 81.7 CFM (NORMAL)
51.7 CFM (INTERMITTENT)

2

| FM | 1 | 2 |
|------------------|----|----|
| After QNW-F-30-N | 44 | 40 |
| In reg. dryer | 55 | 62 |
| Sep. d.c. | 30 | 48 |
| Mill d.c. | 69 | 75 |

xx psig pressures 4/6/00, lgs


FULLER
 A member of the F.L. Smith Group

| |
|---------|
| CFR |
| (1) 0.0 |
| - |
| 0.5 |

PERMITTENT)

PERMITTENT)

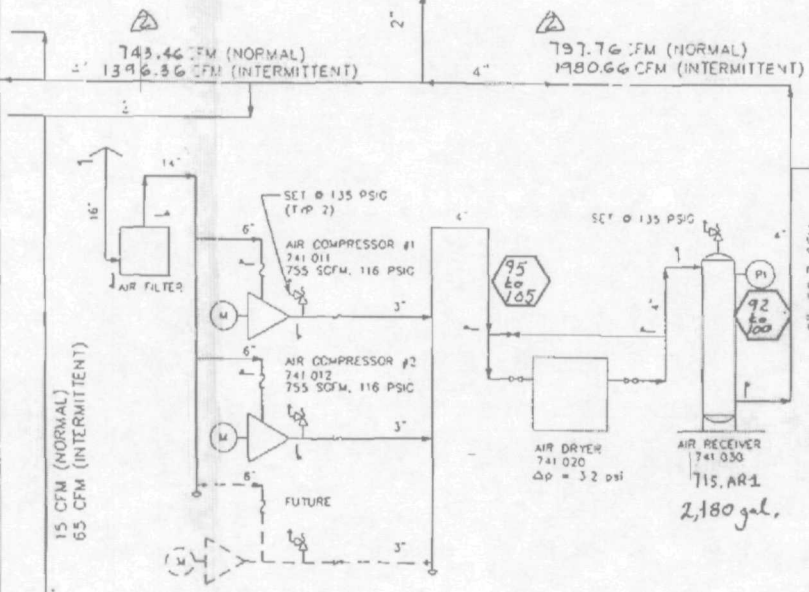
city

| | |
|----------|------|
| KER SILO | CFM |
| VICE AIR | NONE |
| INT AIR | ~ |
| .155 | 25.5 |
| .160 | 0.5 |
| .171 | 0.5 |

| | |
|--------------------|-----|
| CFM (NORMAL) | |
| CFM (INTERMITTENT) | |
| 1.200 | 2.2 |

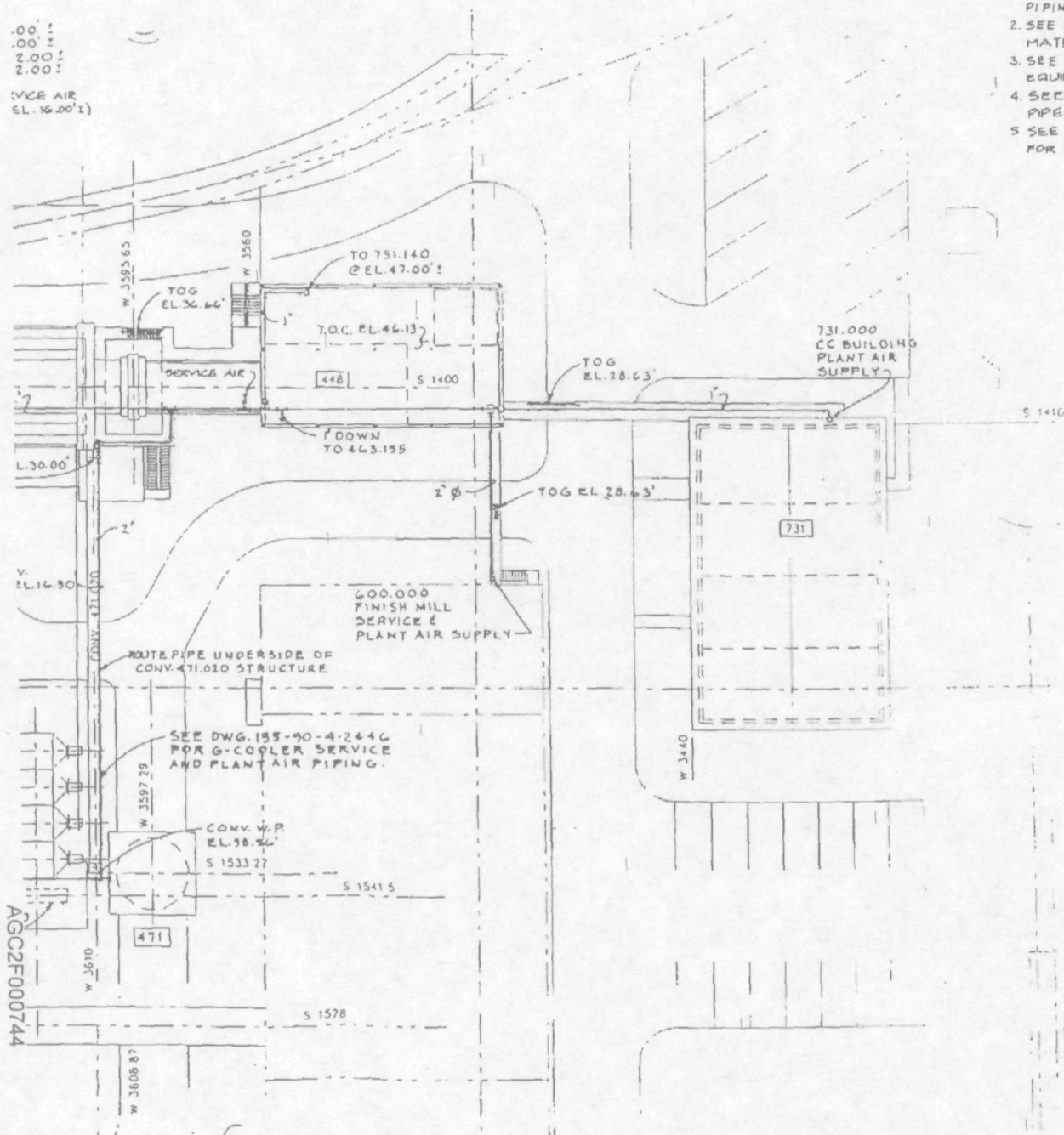
PMAL)
TERMITTENT)

4" 112.56 CFM (NORMAL)
162.56 CFM (INTERMITTENT)




AGC2F000742

VICE AIR
EL. 1600' I)



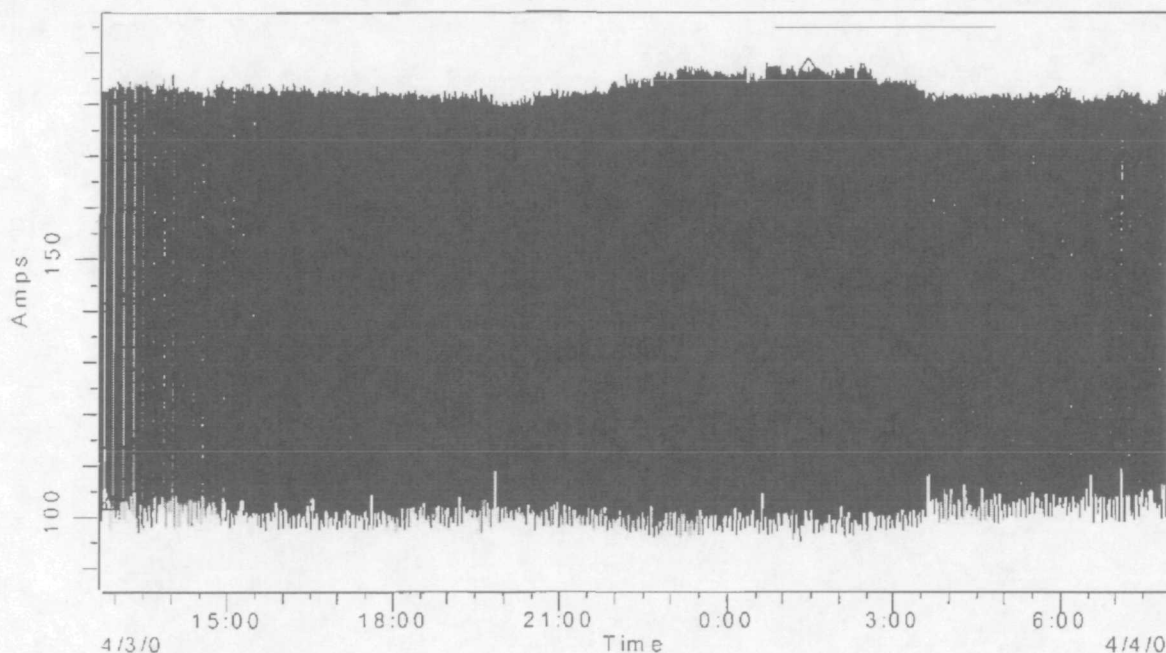
1. PIPING CONTRACTOR SHALL FIELD RUN ALL PIPING TO CLEAR ALL OTHER PIPING AND CONDUIT.
2. SEE DWG. 135-90-4-2438 SHT 1 FOR PIPING MATERIAL SPECIFICATIONS.
3. SEE DWG. 135-90-4-2438 SHT 3 FOR TYPICAL EQUIPMENT AIR CONNECTIONS.
4. SEE DWG. 135-90-4-2438 SHT 2 FOR TYPICAL PIPE SUPPORT DETAILS.
5. SEE DWG. 135-90-4-2401 SHT 1 THRU 8 FOR EQUIPMENT DESCRIPTION.

[illegible] **FULLER**

Time Plot Graph:
air comp 1 ampsof Quincy NW 740-C make-up
compressor

Instrument: ACE 4000 (A498-061824)
Measurements Start At: April 03, 2000 12:44:00.000
Measurements Stop At: April 04, 2000 07:56:19.005
Record each: 1 Second

Description:



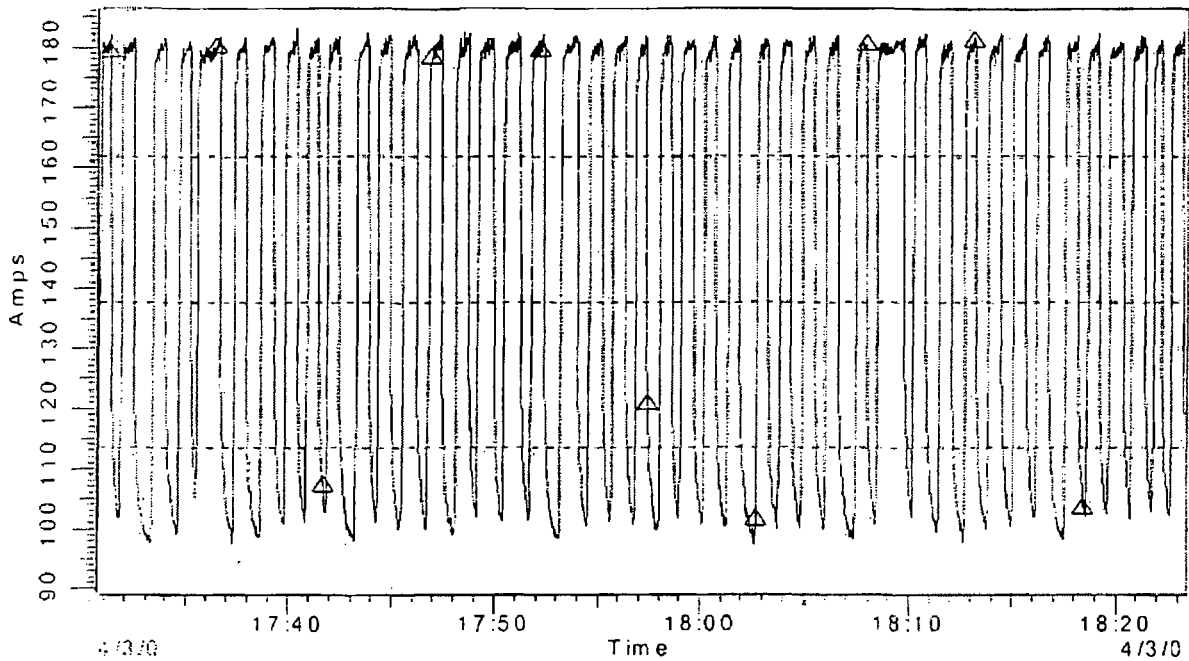
| Measurement | Minimum | Maximum |
|-------------|---------|---------|
|-------------|---------|---------|

| | | |
|---------------------------|--------|--------|
| Current RMS 3-Phase Inst. | 95.10A | 188.1A |
|---------------------------|--------|--------|

Time Plot Graph:
air comp 1 amps

Instrument: ACE 4000 (A498-061824)
Measurements Start At: April 03, 2000 12:44:00.000
Measurements Stop At: April 04, 2000 07:56:19.005
Record each: 1 Second

Description:



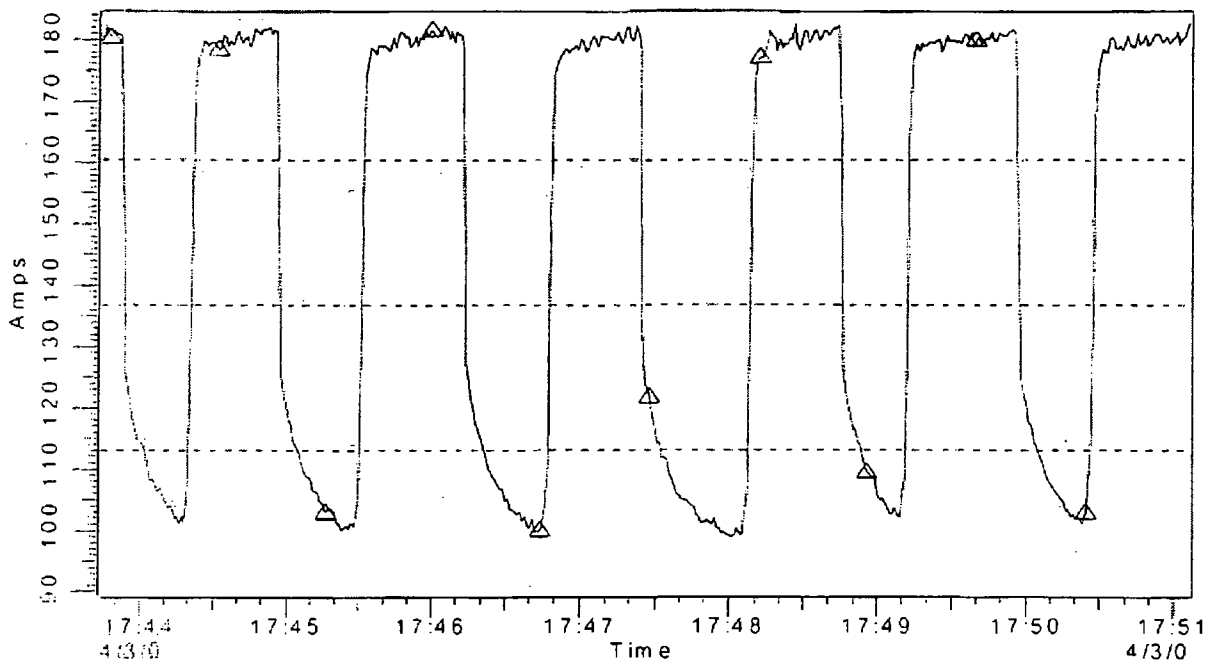
△ Current RMS 3-Phase Inst. [Amps]

| Measurement | Minimum | Maximum |
|-------------|---------|---------|
|-------------|---------|---------|

| | | |
|---------------------------|--------|--------|
| Current RMS 3-Phase Inst. | 97.29A | 183.4A |
|---------------------------|--------|--------|

Time Plot Graph:
aircomp 1 amps

Instrument: ACE 4000 (A498-061824)
Measurements Start At: April 03, 2000 12:44:00.000
Measurements Stop At: April 04, 2000 07:56:19.005
Record each: 1 Second

Description:

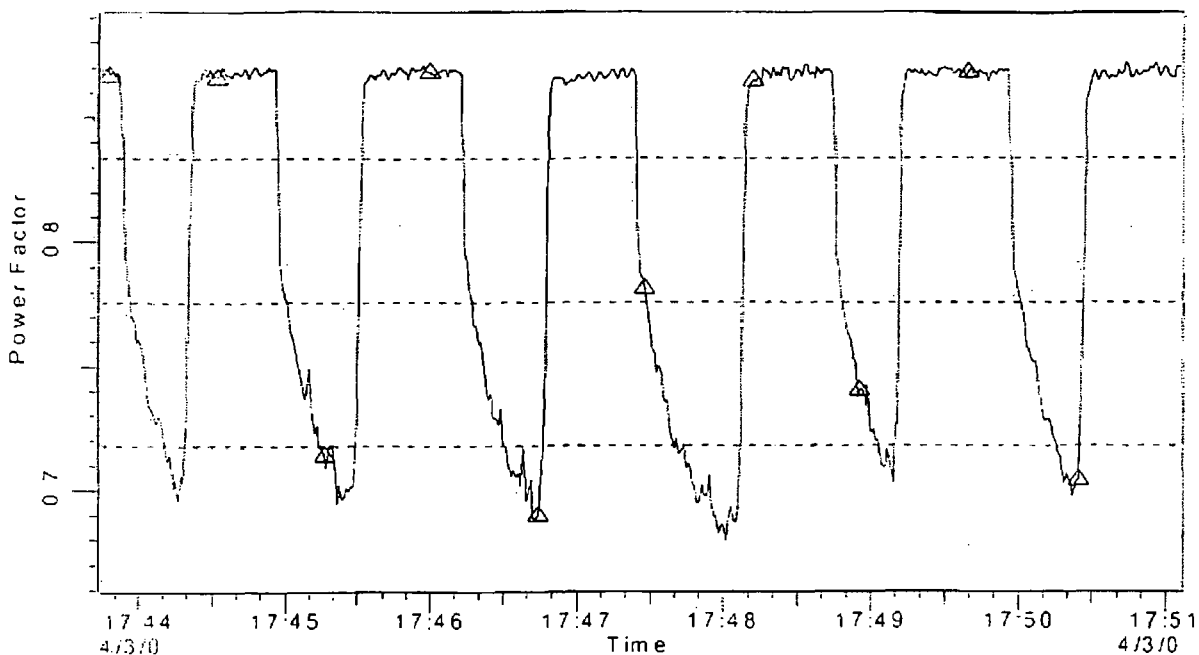
△ Current RMS 3-Phase Inst. [Amps]

| Measurement | Minimum | Maximum |
|--------------------------|---------|---------|
| Current RMS 3-Phase Inst | 98.91A | 182.7A |

Time Plot Graph:
air comp 1 power factor

Instrument: ACE 4000 (A498-061824)
Measurements Start At: April 03, 2000 12:44:00.000
Measurements Stop At: April 04, 2000 07:56:19.005
Record each: 1 Second

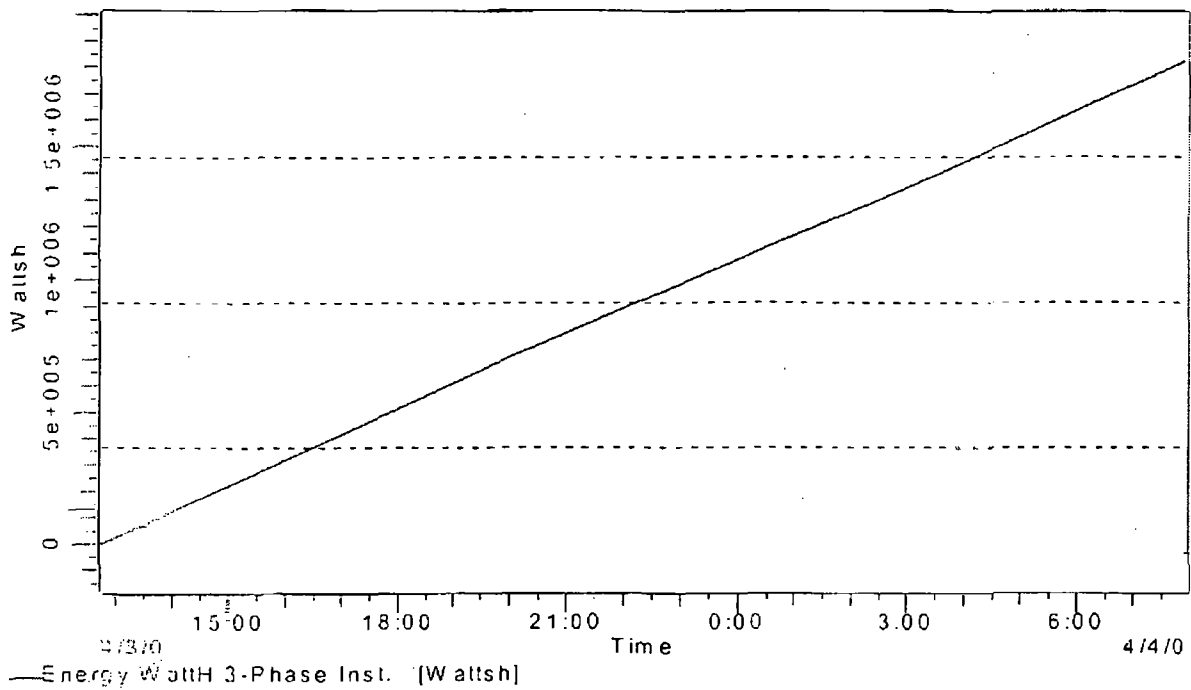
Description:



| Measurement | Minimum | Maximum |
|--------------------------|---------|---------|
| Power P.F. 3-Phase Inst. | 0.679L | 0.873L |

Time Plot Graph:
air comp 1 kwh

Instrument: ACE 4000 (A498-061824)
Measurements Start At: April 03, 2000 12:44:00.000
Measurements Stop At: April 04, 2000 07:56:19.005
Record each: 1 Second

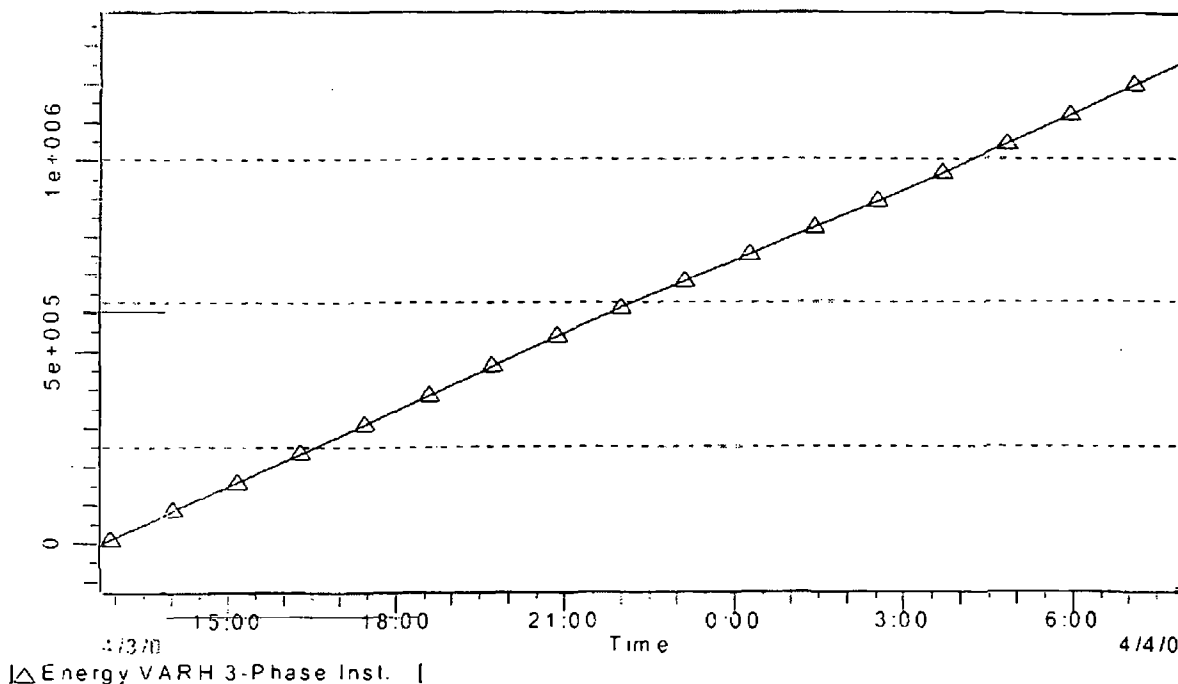
Description:

| Measurement | Minimum | Maximum |
|---------------------------|---------|----------|
| Energy WattH 3-Phase Inst | 0.565Wh | 1.828MWh |

Time Plot Graph:
comp 1 varh

Instrument: ACE 4000 (A498-061824)
Measurements Start At: April 03, 2000 12:44:00.000
Measurements Stop At: April 04, 2000 07:56:19.005
Record each: 1 Second

Description:



| Measurement | Minimum | Maximum |
|-------------|---------|---------|
|-------------|---------|---------|

| | | |
|---------------------------|-----------|------------|
| Energy VARH 3-Phase Inst. | 0.329VARh | 1.258MVARh |
|---------------------------|-----------|------------|

Ash Grove Cement Company, Seattle Plant
Summary of Motor List Data

| Department | Connected Motor Tagname HP | % of grand total | HP-hr /ton cl | HP-hr /ton cmt |
|----------------------------------|----------------------------|------------------|---------------|----------------|
| Quarry | 1,621 | 7% | 16.2 | |
| Raw Grinding | 4,129 | 18% | 41.3 | |
| Kiln Feed Storage and Blending | 550 | 2% | 5.5 | |
| Fuels | 1,269 | 6% | 12.7 | |
| Pyroprocessing | 3,912 | 17% | 39.1 | |
| Subtotal | | | 114.8 | 109.3 |
| Clinker Grinding | 7,674 | 34% | | 72.9 |
| Cement Bulk Loadout | 2,459 | 11% | | 23.4 |
| Plant General | 795 | 4% | | 7.6 |
| Total | 22,408 | 100% | | |
| Total/ton cmt | | | | 213.1 |
| ton/day clinker | 2,400 | | | |
| ton/day cement | 2,526 | | | |
| clk/cmt ratio | 0.9517 | | | |
| potential kwh/ton | | | | 159 |
| 1999 plant actual kwh/ton cement | | | | 113 |

Quarry: from extraction of rock from the quarry and receipt and handling of raw materials to delivery of crushed rock to storage and possibly blending. Identified as department "Raw Material Handling" in motor list overleaf.

Raw Grinding: from withdrawal of rock from storage to delivery of kiln feed /slurry to the kiln feed storage and blending system. Identified as department "Raw Mill" in motor list overleaf.

Kiln Feed Storage and Blending: kiln feed storage and blending. Identified as department "Blending" in motor list overleaf.

Fuels: from raw fuel unloading through firing in kiln.

Pyroprocessing: from withdrawal of kiln feed from storage to delivery of clinker to storage. Sum of departments identified as "Kiln" and "Clinker Handling" in motor list overleaf.

Clinker Grinding: from withdrawal of clinker from storage to delivery of cement to storage. Identified as department "Finish Grind" in motor list overleaf.

Cement Bulk loadout: from withdrawal of cement from storage to delivery into truck and rail. Identified as department "Shipping" in motor list overleaf.

Cement Packaging: bagging systems.

Plant General: plant compressed air system, water pumps, and other miscellaneous utilities. Identified as department "Utilities" in motor list overleaf.

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|-------------|--|-------------------|-----|------------|
| Old | New | | | | |
| 151.010 | 311.BC1 | Stacker yard belt drive(north end) | Raw Mat'l Handl'g | 100 | 115 |
| 151.022 | 311.BC2 | Stacker boom belt | Raw Mat'l Handl'g | 40 | 50 |
| 151.024W | 311.ST1.1XW | Stacker traverse West | Raw Mat'l Handl'g | 20 | 27 |
| 151.024E | 311.ST1.1XE | Stacker traverse East | Raw Mat'l Handl'g | 20 | 27 |
| 151.029 | 311.HS1 | Stacker hydraulic pump | Raw Mat'l Handl'g | | |
| 151.130W | 311.RE1.1XW | Reclaimer traverse drive West | Raw Mat'l Handl'g | | |
| 151.130E | 311.RE1.1XE | Reclaimer traverse drive East | Raw Mat'l Handl'g | | |
| 151.200 | 311.BC3 | Reclaimer yard belt drive(south end) | Raw Mat'l Handl'g | 25 | 30 |
| 152.020A | 312.FA1 | Additive apron feeder (truck dump) | Raw Mat'l Handl'g | 20 | 32 |
| 152.020B | 312.CR1 | Additive lump breaker (truck dump) | Raw Mat'l Handl'g | | |
| 152.030 | 312.FN1 | Additive D/C fan (truck dump) | Raw Mat'l Handl'g | 7.5 | 9 |
| 152.040 | 312.BC1 | Additive conveyor belt to TT-8 | Raw Mat'l Handl'g | 40 | 47 |
| 152.050 | 312.BC3 | Clay reversible belt (TT-8) | Raw Mat'l Handl'g | 10 | 13 |
| 152.064 | 312.FZ1 | D/C main fan TT-8 | Raw Mat'l Handl'g | 15 | 17 |
| 152.100 | 312.BC4 | Additive conveyor belt TT-8 to TT-6 | Raw Mat'l Handl'g | 30 | 36 |
| 154.010 | 313.BC1 | Conveyor Belt TT-6 to 331 Steel/Silica bin | Raw Mat'l Handl'g | 30 | |
| 154.020 | 314. | Slag unload belt beater/cleaner | Raw Mat'l Handl'g | 3 | 4.4 |
| 155.020 | 314.BC1 | Slag unload belt @ rail unloading | Raw Mat'l Handl'g | 25 | 30 |
| 155.040 | 314.BC2 | Conveyor belt to Silica bin, 331 tower | Raw Mat'l Handl'g | 7.5 | 9 |
| 155.054 | 314.FZ1 | D/C main fan steel/silica bins 331 tower | Raw Mat'l Handl'g | 40 | 46 |
| 161.010 | 311.BC4 | Conveyor belt TT-3 to TT-4 | Raw Mat'l Handl'g | 10 | 13 |
| 161.017 | 311.FZ2 | D/C main fan TT-3/TT-4 | Raw Mat'l Handl'g | 15 | 19 |
| 161.020 | 311.BC5 | Conveyor belt TT-4 to TT-5 | Raw Mat'l Handl'g | 40 | 45.5 |
| 161.022B | 311.BC6 | Cleaning belt, Magnetic separator, reclaimer | Raw Mat'l Handl'g | 3 | 4.5 |
| 163.010 | 311.BC7 | Conveyor belt TT-5 to TT-6 | Raw Mat'l Handl'g | 15 | 19 |
| 163.024 | 311.FZ3 | D/C main fan TT-5 | Raw Mat'l Handl'g | 10 | 13 |
| 163.030 | 311.BC8 | Conveyor belt TT-6 to clay/limestone bins | Raw Mat'l Handl'g | 50 | 58 |
| 163.040 | 311.BC9 | Reversible belt clay or limestone(331 twr) | Raw Mat'l Handl'g | 15 | 19 |
| 163.054 | 311.FZ4 | D/C main fan clay/limestone bins | Raw Mat'l Handl'g | 40 | 46 |
| 163.064 | 311.FZ5 | D/C main fan TT-6 | Raw Mat'l Handl'g | 25 | 30 |
| 340.021 | 316.FN1 | D/C main fan, Fly Ash bin | Raw Mat'l Handl'g | | |
| 340.030 | 316.AE1 | Aeration blower, Fly Ash | Raw Mat'l Handl'g | | |
| 340.040 | 316.BL1 | Conveying blower, Fly Ash | Raw Mat'l Handl'g | | |
| 340.050 | 316.PZ2 | Conveying pump, Fly Ash | Raw Mat'l Handl'g | | |
| 340.060 | 316.SF1 | Screw feeder, Fly Ash | Raw Mat'l Handl'g | | |
| 474.010 | 512.BC1 | Conveyor belt, TT11 to silos | Raw Mat'l Handl'g | 125 | 151 |
| 781.011 | 211.HT1 | Hoist, Loader; Barge Unloading | Raw Mat'l Handl'g | 200 | 27 |

| Seattle Electrical Motor List | | | | |
|-------------------------------|-------------|--|------------------|-------|
| EQUIPMENT # | | Equipment Description | Department | HP |
| Old | New | | | |
| 800.020 | 117.BC1 | Conveyor, Belt; Barge | Raw Mat'l Handlg | 60 |
| 800.030 | 117.BC2 | Conveyor, Belt; Barge | Raw Mat'l Handlg | |
| 800.032 | 117.HT1 | Hoist, TT09 | Raw Mat'l Handlg | 25 |
| 800.040 | 117.BC3 | Conveyor, Belt; TT09 to TT10A | Raw Mat'l Handlg | 60 |
| 800.041 | 117.BC4 | Conveyor, Belt; TT10A to TT02 | Raw Mat'l Handlg | 75 |
| 800.060 | 117.BC5 | Conveyor, Belt; TT10 to TT11 | Raw Mat'l Handlg | 100 |
| 800.205 | 117.BC6 | Conveyor, Belt, to Radial Stacker, TT11 to TT11A | Raw Mat'l Handlg | 30 |
| 800.210 | 117.BC7 | Conveyor, Belt, Radial Stacker | Raw Mat'l Handlg | 40 |
| 800.210B | 117.HS1 | Hydraulic System, Radial Stacker; TT11A | Raw Mat'l Handlg | |
| 800.220 | 117.BC8 | Conveyor, Belt; TT14 to TT15 | Raw Mat'l Handlg | |
| 800.240 | 117.BC9 | Conveyor, Belt, Reversible; TT15 to piles | Raw Mat'l Handlg | |
| 800.250 | 117.BCA | Conveyor, Belt; TT15 to South Pile | Raw Mat'l Handlg | |
| 151.110 | 311.DC1 | Reclaimer scraper chain drive | Raw Mat'l Handlg | 100 |
| 151.120 | 311.RE1.1X1 | Reclaimer harrow drive | Raw Mat'l Handlg | |
| | | SUBTOTAL | | 1,471 |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 150 |
| | | TOTAL | | 1,621 |
| 331.050 | 315.WF1 | Limestone weigh feeder(331 twr) | Raw Mill | |
| 331.060A | 315.FA1 | Clay apron feeder(331 twr) | Raw Mill | 7.5 |
| 331.080 | 315.BC1 | Clay belt, apron feeder to main belt(331 twr) | Raw Mill | 7.5 |
| 331.120 | 315.WF2 | Silica weigh feeder(331 twr) | Raw Mill | 0.5 |
| 331.140 | 315.WF3 | Steel slag weigh feeder(331 twr) | Raw Mill | 0.5 |
| 331.150 | 315.BC2 | Belt, silica/slag feeders to main belt(331 twr) | Raw Mill | |
| 331.170 | 315.BC3 | Conveyor belt, 331 tower to TT-7 | Raw Mill | 20 |
| 331.190 | 315.BC4 | Conveyor belt, TT-7 to Raw Mill | Raw Mill | 20 |
| 331.334 | 315.FZ1 | D/C main fan TT-7 | Raw Mill | 5 |
| 341.010 | 316.TG1 | Hydraulic pump, triple gate | Raw Mill | |
| 341.020 | 316.MR1 | Raw Mill | Raw Mill | 1750 |
| 341.022A | 316.LP1 | Pump, lube return #1, Raw Mill | Raw Mill | 0.5 |
| 341.022B | 316.LP2 | Pump, lube supply #1, Raw Mill | Raw Mill | 0.5 |
| 341.022C | 316.LP3 | Pump, lube return #2, Raw Mill | Raw Mill | 0.5 |
| 341.022D | 316.LP4 | Pump, lube supply #2, Raw Mill | Raw Mill | 0.5 |
| 341.022E | 316.LP5 | Pump, lube return #3, Raw Mill | Raw Mill | 0.5 |
| 341.022F | 316.LP6 | Pump, lube supply #3, Raw Mill | Raw Mill | 0.5 |

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|--|------------|-------|------------|
| Old | New | | | | |
| 341.022G | 316.LP7 | Pump, lube return #4, Raw Mill | Raw Mill | 0.5 | 0.95 |
| 341.022H | 316.LP8 | Pump, lube supply #4, Raw Mill | Raw Mill | 0.5 | 0.95 |
| 341.024A | 316.LP9 | Pump, low pressure, Raw Mill | Raw Mill | 15 | |
| 341.024B | 316.LPA | Pump, high pressure, Raw Mill | Raw Mill | 15 | |
| 341.026 | 316.SR1 | Classifier, Raw Mill | Raw Mill | 75 | 36 |
| 341.028A | 316.WP1 | Pump, water spray #1, Raw Mill | Raw Mill | 20 | 25 |
| 341.028B | 316.WP2 | Pump, water spray #2, Raw Mill | Raw Mill | 20 | 25 |
| 341.030 | 316.PZ1 | Pump, hydraulic spring system, Raw Mill | Raw Mill | 30 | 36 |
| 341.032 | 316.PZ3 | Grease pump, Raw Mill | Raw Mill | 0.5 | |
| 341.065 | 316.WP3 | Water well pump, Raw Mill | Raw Mill | 3 | |
| 341.206 | 317.FZ2 | Airslide fan, cyclone to airlift, Raw Mill | Raw Mill | 5 | |
| 341.210 | 316.FZ1 | Fan, Raw Mill | Raw Mill | 1750 | 231 |
| 351.012 | 317.BL1 | Airlift blower, RM to blenders | Raw Mill | 350 | 47 |
| | | SUBTOTAL | | 4,099 | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 30 | |
| | | TOTAL | | 4,129 | |
| | | | | | |
| 351.022 | 317.BL2 | Blower, airstide, top of blend silos | Blending | 5 | 6 |
| 351.034 | 317.FZ3 | D/C main fan, blend silos, top(E) | Blending | 20 | 25 |
| 361.030A | 411.CP1 | Blending Compressor, P/H comp room(E) | Blending | 150 | 198 |
| 361.051A | 411.CP2 | Aeration Compressor, P/H comprm(W) | Blending | 100 | 134 |
| 361.052A | 411.CP3 | Aeration Compressor, P/H comprm(C) | Blending | 100 | 134 |
| 361.082 | 411.BL1 | Airslide Blower, blend silos mechrn | Blending | 15 | 19 |
| 361.094 | 411.FZ1 | D/C main fan, Blend silos top(W) | Blending | 40 | 46 |
| 361.102 | 411.BL2 | Aeration Blower #1, blower room (C) | Blending | 60 | 70 |
| 361.104 | 411.BL3 | Aeration Blower #2, blower room (E) | Blending | 60 | 70 |
| | | TOTAL | | 550 | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 0 | |
| | | TOTAL | | 550 | |
| | | | | | |
| | | | | | |
| 212.020 | 41A.AF1 | Apron feeder coal(truck dump) | Fuels | 15 | 19 |
| 212.040 | 41A.BF1 | D/C main fan coal(truck dump) | Fuels | 7.5 | 9 |
| 212.050 | 41A.BC1 | Conveyor belt, coal to TT-5 | Fuels | 60 | 70 |
| 212.052B | 41A.BC2 | Cleaning belt magnetic separator, coal | Fuels | | |
| 212.064 | 41A.FZ1 | D/C main fan TT-5, coal | Fuels | 7.5 | 9 |
| 212.084 | 41A.FZ2 | D/C main fan, coal silos | Fuels | 3 | 4 |

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|---|------------|-------|------------|
| Old | New | | | | |
| 461.020 | 41B.WF1 | weigh feeder CM#1 | Fuels | 0.5 | 2.5 |
| 461.040 | 41B.BC1 | conveyor belt, coal to CM#1 | Fuels | 5 | 6 |
| 461.060 | 41B.FN1 | D/C fan, chute CM#1 | Fuels | 5 | 6 |
| 461.120 | 41B.WF2 | weigh feeder CM#2 | Fuels | 0.5 | 2.5 |
| 461.140 | 41B.BC2 | conveyor belt, coal to CM#2 | Fuels | 5 | 6 |
| 461.160 | 41B.FN2 | D/C fan, chute CM#2 | Fuels | 5 | 6 |
| 462.020A | 41B.MW1 | CM#1 main drive | Fuels | 150 | 182 |
| 462.020B | 41B.BL1 | Blower, hot air CM#1 | Fuels | 5 | 6 |
| 462.020C | 41B.RF1 | Rotary feeder CM#1 | Fuels | 2 | 2.8 |
| 462.060 | 41B.FZ1 | CM#1 D/C fan | Fuels | 100 | 115 |
| 462.065 | 41B.FZ2 | Fan, hot air booster, CM#1 | Fuels | 40 | 46 |
| 462.120A | 41B.MW2 | CM#2 main drive | Fuels | 150 | 182 |
| 462.120B | 41B.BL2 | Blower, hot air CM#2 | Fuels | 5 | 6 |
| 462.120C | 41B.RF2 | Rotary feeder CM#2 | Fuels | 2 | 2.8 |
| 462.160 | 41B.FZ3 | CM#2 D/C fan | Fuels | 100 | 115 |
| 462.165 | 41B.FZ4 | Fan, hot air booster, CM#2 | Fuels | 40 | 46 |
| 462.210 | 41B.SC1 | Conveyor screw, D/C CM | Fuels | 5 | 6 |
| 462.220 | 41B.MP1 | CM FK pump | Fuels | 25 | 30 |
| 462.240A | 41B.CP1 | CM FK compressor | Fuels | 60 | 72 |
| 463.111 | 41C.FZ1 | Fan, D/C PF bin | Fuels | 5 | |
| 463.112 | 41C.AG1 | Agitator, PF bin discharge | Fuels | 7.4 | 9.5 |
| 463.140 | 41C.WF1 | Kiln PFISTER | Fuels | 8.2 | |
| 463.161 | 41C.BL2 | Blower #1 Kiln Pfister(cen W) | Fuels | 125 | 137 |
| 463.162 | 41C.BL4 | Blower, #2 Kiln Pfister(W) | Fuels | 125 | 137 |
| 463.210 | 41C.WF2 | Feeder, Pfister#2, Calciner | Fuels | 6.3 | |
| 463.231 | 41C.BL1 | Blower #1, Calciner Pfister(E) | Fuels | 75 | 87 |
| 463.232 | 41C.BL3 | Blower #2, Calciner Pfister(cen E) | Fuels | 75 | 87 |
| 465.010 | 41F.FD1 | Feeder, walking floor, Tire system | Fuels | 1.5 | 2.5 |
| 465.020 | 41F.AC1 | Singulator, Tire system | Fuels | 3 | 4.4 |
| 465.030 | 41F.BC1 | Conveyor belt, rejector, Tire system | Fuels | 1 | |
| 465.040 | 41F. | Rejector, Tire system | Fuels | 1 | |
| 465.050 | 41C.BC2 | Conveyor belt, elevator feed, Tire system | Fuels | 3 | |
| 465.055 | 41F.VZ1 | Centering table, Tire system | Fuels | 3 | |
| 465.060 | 41F.EL1 | Elevator, Tire system | Fuels | 5 | |
| 465.070 | 41F.BC3 | Conveyor belt, upper, tire system | Fuels | 2 | |
| 465.080 | 41F.VZ2 | High speed roller, Tire system | Fuels | 3 | |
| 465.082 | 41F.VZ3 | Low speed roller, Tire system | Fuels | 2 | |
| 212.060 | 41A.RF1 | Rotary feeder, airlock TT05 coal | Fuels | | 2 |
| | | SUBTOTAL | | 1,249 | |

| Seattle Electrical Motor List | | | | | |
|-------------------------------|---------|--|------------|-------|---------|
| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
| Old | New | | | | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 20 | |
| | | TOTAL | | 1,269 | |
| 212.070 | 41A.BC3 | Conveyor belt TT-5 to coal silo | Kiln | 25 | 30 |
| 342.020A | 317.MA1 | Fan, Preheater ID | Kiln | 1000 | |
| 342.020C | 317.MA2 | Turning motor, Preheater ID fan | Kiln | 60 | |
| 342.031 | 413.SC1 | Conveyor, screw, hopper #1, Baghouse | Kiln | 3 | 4 |
| 342.032 | 413.SC2 | Conveyor, screw, hopper #2, Baghouse | Kiln | 3 | 4 |
| 342.033 | 413.SC3 | Conveyor, screw, hopper #3, Baghouse | Kiln | 3 | 4 |
| 342.034 | 413.SC4 | Conveyor, screw, hopper #4, Baghouse | Kiln | 3 | 4 |
| 342.035 | 413.SC5 | Conveyor, screw, hopper #5, Baghouse | Kiln | 3 | 4 |
| 342.036 | 413.SC6 | Conveyor, screw, hopper #6, Baghouse | Kiln | 3 | 4 |
| 342.037 | 413.SC7 | Conveyor, screw, hopper #7, Baghouse | Kiln | 3 | 4 |
| 342.038 | 413.SC8 | Conveyor, screw, hopper #8, Baghouse | Kiln | 3 | 4 |
| 342.039 | 413.SC9 | Conveyor, screw, hopper #9, Baghouse | Kiln | 3 | 4 |
| 342.040 | 413.SCA | Conveyor, screw, hopper #10, Baghouse | Kiln | 3 | 4 |
| 342.041 | 413.SCB | Conveyor, screw, hopper #11, Baghouse | Kiln | 3 | 4 |
| 342.042A | 413.SCE | Conveyor, screw, gathering #1,(E) B/H | Kiln | 20 | 25 |
| 342.042B | 413.SCW | Conveyor, screw, gathering #2(W), B/H | Kiln | 20 | 25 |
| 342.045 | 413.FZ2 | Fan, reverse air, Baghouse | Kiln | 125 | 137 |
| 342.050A | 413.SCS | Screw conveyor #1(S) B/H return dust | Kiln | 20 | 23 |
| 342.050B | 413.SCN | Screw conveyor #2(N) B/H return dust | Kiln | 20 | 23 |
| 342.060 | 413.SCC | Screw conveyor #2, Baghouse | Kiln | 25 | 30 |
| 342.065 | 413.SCD | Screw conveyor #3 B/H to RM airlift | Kiln | 7.5 | 9 |
| 342.110 | 413.FZ1 | Main Baghouse Fan | Kiln | 500 | 805 |
| 361.120A | 412.SC1 | 30" Screw conveyor, W | Kiln | 50 | 58 |
| 361.120B | 412.SC2 | 30" Screw conveyor, E | Kiln | 50 | 58 |
| 361.130 | 412.BE1 | Bucket Elevator kiln feed | Kiln | 60 | 70 |
| 361.152 | 412.BL2 | Aeration Blower, Cal Bin, blower rm(W) | Kiln | 25 | 30 |
| 361.202 | 412.BL1 | Airlift Blower, kiln feed, blower rm (S) | Kiln | 300 | 39 |
| 361.212 | 412.FZ2 | Airslide fan, 1st cyclone(7th) | Kiln | 2 | |
| 361.304 | 413.FZ3 | D/C main fan, Cal bin | Kiln | 30 | 36.2 |
| 431.010A | 416.MM1 | Kiln Main Drive | Kiln | 500 | 810 |
| 431.010B | 416.MM2 | Kiln Auxiliary Drive | Kiln | 50 | 58 |
| 431.030 | 416.KT1 | Kiln Hydraulic Thrust Hydraulic Pump | Kiln | 1.5 | |
| 431.151 | 416.FN1 | Fan shell cooling, #1 | Kiln | 5 | |
| 431.152 | 416.FN2 | Fan shell cooling, #2 | Kiln | 5 | |
| 431.153 | 416.FN3 | Fan shell cooling, #3 | Kiln | 5 | |

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|--|------------|-----|------------|
| Old | New | | | | |
| 431.154 | 416.FN4 | Fan shell cooling, #4 | Kiln | 5 | |
| 431.155 | 416.FN5 | Fan shell cooling, #5 | Kiln | 5 | |
| 431.156 | 416.FN6 | Fan shell cooling, #6 | Kiln | 5 | |
| 431.157 | 416.FN7 | Fan shell cooling, #7 | Kiln | 5 | |
| 431.158 | 416.FN8 | Fan shell cooling, #8 | Kiln | 5 | |
| 431.159 | 416.FN9 | Fan shell cooling, #9 | Kiln | 5 | |
| 431.160 | 416.FNA | Fan shell cooling, #10 | Kiln | 5 | |
| 431.161 | 416.FNB | Fan shell cooling, #11 | Kiln | 5 | |
| 431.162 | 416.FNC | Fan shell cooling, #12 | Kiln | 5 | |
| 431.163 | 416.FND | Fan shell cooling, #13 | Kiln | 5 | |
| 431.164 | 416.FNE | Fan shell cooling, #14 | Kiln | 5 | |
| 431.165 | 416.FNF | Fan shell cooling, #15 | Kiln | 5 | |
| 431.310 | 416.HC1 | Hammer crusher | Kiln | 75 | 90 |
| 431.315 | 416.DV1 | Diverter to Pan Conveyor or Waste | Kiln | 1 | |
| 431.320 | 416.TU1 | Burner Trolley Drive | Kiln | 1.5 | |
| 431.360A | 416.FNG | Fan, Pipe Girder Cooling #1 | Kiln | 5 | |
| 431.360B | 416.FNH | Fan, Pipe Girder Cooling #2 | Kiln | 5 | |
| 431.420 | 418.BL4 | FAN, emergency air, Kiln Burner | Kiln | 5 | 6.15 |
| 431.440 | 418.BL2 | FAN, primary air Kiln | Kiln | 125 | 136 |
| 471.020 | 419.DB1 | Pan conveyor, clinker to G-cooler | Kiln | 25 | 30 |
| 471.060 | 419.FZ2 | Fan, booster, Diversion bin | Kiln | | |
| 471.074 | 419.FZ1 | D/C main fan, G-cooler | Kiln | 75 | 87 |
| 471.101 | 419.FN1 | G-Cooler fan; #1 2 SPEED | Kiln | 30 | 37 |
| 471.102 | 419.FN2 | G-Cooler Fan; #2 2 SPEED | Kiln | 30 | 37 |
| 471.103 | 419.FN3 | G-Cooler Fan #3; 2 SPEED | Kiln | 30 | 37 |
| 471.104 | 419.FN4 | G-Cooler Fan #4; 2 SPEED | Kiln | 30 | 37 |
| 471.105 | 419.DC1 | G-Cooler Drag Chain, Top | Kiln | 25 | 30 |
| 471.110 | 419.DC2 | Conveyor, drag chain, G-cooler bottom | Kiln | 20 | |
| 471.150 | 419.BC1 | Conveyor belt, G-cooler to clinker silos | Kiln | 40 | |
| 771.009 | 413.WP1 | Pump, Water; Downcomer Spray | Kiln | | |
| 771.010 | 413.CP1 | Compressor, Air; Downcomer Spray | Kiln | 75 | |
| 772.015 | 413.RF2 | Feeder, Rotary; Sorbent Addition | Kiln | | |
| 773.021 | 413.FN2 | Main Fan, D/C; Sorbent Addition | Kiln | | |
| 772.030 | 413.BL1 | Blower, Aeration; Sorbent Addition | Kiln | 5 | 6.8 |
| 772.040 | 413.BL2 | Blower, Conveying; Sorbent Addition | Kiln | 5 | 7 |
| 772.060 | 413.SF1 | Feeder, Screw; Sorbent Addition | Kiln | 2 | 3.4 |
| 772.080 | 413.BL3 | Blower, Conveying; Manual Sorbent Addition | Kiln | 4 | |
| 772.090 | 413.SF2 | Feeder, Screw; Manual Sorbent Addition | Kiln | 1 | |

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|--|------------------|-------|------------|
| Old | New | | | | |
| 361.174 | 412.FZ1 | Fan, airslide cal airslide to airlift | Kiln | 5 | 6 |
| | | SUBTOTAL | | 3,619 | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 40 | |
| | | TOTAL | | 3,659 | |
| 470.020 | 41G.BF1 | D/C, loading spout, Clinker Rail loadout | Clinker Hand'l'g | | |
| 470.040 | 41G.TU1 | Positioner, loading spout, Clinker Rail loadout | Clinker Hand'l'g | | |
| 472.010 | 419.BC5 | Conveyor belt, silos to shed | Clinker Hand'l'g | 7.5 | 7 |
| 473.010 | 419.BC6 | Conveyor belt, clinker shed with tripper | Clinker Hand'l'g | 10 | |
| 473.020 | 419.TR1 | Tripper, clinker shed | Clinker Hand'l'g | | |
| | 419.DC3 | Drag Chain on top of clinker silos | Clinker Hand'l'g | | |
| 474.121 | 419.FNC | D/C Main fan, clinker silos top(N cen) | Clinker Hand'l'g | 10 | |
| 474.122 | 419.FN6 | D/C Blowback fan, clinker silos top(N cen) | Clinker Hand'l'g | 10 | |
| 474.131 | 419.FN7 | D/C Main fan, clinker silos top(SW) | Clinker Hand'l'g | 15 | |
| 474.132 | 419.FNA | D/C Blowback fan, clinker silos top(SW) | Clinker Hand'l'g | 2 | |
| 474.141 | 419.FN5 | D/C Main fan, clinker silos top(S cen) | Clinker Hand'l'g | 15 | |
| 474.142 | 419.FN8 | D/C Blowback fan, clinker silos top(S cen) | Clinker Hand'l'g | 2 | |
| 474.151 | 419.FN9 | D/C Main fan, clinker silos top(SE) | Clinker Hand'l'g | 15 | |
| 474.152 | 419.FN8 | D/C Blowback fan, clinker silos top(SE) | Clinker Hand'l'g | 2 | |
| 474.160 | 419.CP1 | Compressor air for flop gates, clinker silos top | Clinker Hand'l'g | 2 | |
| 475.031 | 511.FN1 | D/C Main fan, clinker shed | Clinker Hand'l'g | 20 | 24 |
| 475.040 | 511.BC1 | Conveyor belt, shed to silos | Clinker Hand'l'g | 25 | |
| 475.050 | 511.BE1 | Elevator, bucket, clinker shed | Clinker Hand'l'g | 40 | 51.5 |
| 475.060 | 511.BC2 | Conveyor belt, shed to bucket elevator | Clinker Hand'l'g | 7.5 | |
| 475.100 | 511.BC3 | Conveyor belt, shed belt to diverter | Clinker Hand'l'g | 10 | |
| 480.100 | 511.FZ1 | Fan vent, clinker silos(S) | Clinker Hand'l'g | | |
| 480.101 | 511.FZ2 | Fan vent, clinker silos(N) | Clinker Hand'l'g | | |
| | | SUBTOTAL | | 193 | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 60 | |
| | | TOTAL | | 253 | |
| 531.010 | 511.TR1 | Tripper, FM | Finish Grind | | |
| 641.175 | 524.PZ5 | Pump, lubrication packing gland, FM#2 | Finish Grind | | |
| 531.030 | 511.BC5 | Conveyor belt, silos to FM | Finish Grind | | |
| 531.040 | 511.BC6 | Conveyor belt, silos 3/8 to main belt | Finish Grind | | |
| 531.042 | 511.FN3 | D/C Main fan, clinker silo 3 vib fdr | Finish Grind | | |
| 531.050 | 511.BC7 | Conveyor belt, silos 1/7 to main belt | Finish Grind | | |

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|---|--------------|------|------------|
| Old | New | | | | |
| 531.052 | 511.FN4 | D/C Main fan, clinker silo 1 vib fdr | Finish Grind | | |
| 531.060 | 511.BC8 | Conveyor belt, silos 5 to main belt | Finish Grind | | |
| 531.062 | 511.FN5 | D/C Main fan, clinker silo 5 vib fdr | Finish Grind | | |
| 531.080 | 511.FN6 | D/C Main fan, clinker silos bottom(W) | Finish Grind | | |
| 531.081 | 511.FN7 | D/C Blowback fan, clinker silos bottom(W) | Finish Grind | | |
| 531.085 | 511.FN8 | D/C Main fan, clinker silos bottom(E) | Finish Grind | | |
| 531.086 | 511.FN9 | D/C Blowback fan, clinker silos bottom(E) | Finish Grind | | |
| 631.040 | 513.WF1 | Feeder, weigh, clinker silo #1, FM#1 | Finish Grind | | |
| 631.050 | 513.WF2 | Feeder, weigh, clinker silo #2, FM#1 | Finish Grind | | |
| 631.060 | 513.WF3 | Feeder, weigh, gypsum #3A, FM#1 | Finish Grind | | |
| 631.070 | 513.FZ1 | D/C Main fan, mill feed, FM#1 | Finish Grind | 10 | 13.4 |
| 631.091 | 513.FZ2 | D/C Main fan, bin vent, FM#1 | Finish Grind | | |
| 631.110 | 513.BC1 | Conveyor belt, mill feed, FM#1 | Finish Grind | | |
| 631.130 | 514.PZ1 | Pump trunion lift, input, FM#1 | Finish Grind | 1 | 2 |
| 631.140 | 514.PZ2 | Pump trunion lift, discharge, FM#1 | Finish Grind | 1 | 2 |
| 631.150 | 514.PZ3 | Pump lube, input, FM#1 | Finish Grind | 1 | 2 |
| 631.160 | 514.PZ4 | Pump lube, discharge, FM#1 | Finish Grind | 1 | 2 |
| 631.175 | 514.PZ5 | Pump, lubrication packing gland, FM#1 | Finish Grind | | |
| 631.180 | 514.MA1 | Motor, FM#1 | Finish Grind | 2500 | 277 |
| 631.210 | 514.SC1 | Conveyor screw weighing, FM#1 | Finish Grind | 20 | 25.7 |
| 631.220 | 514.SZ1 | Separator air, FM#1 | Finish Grind | 100 | 115 |
| 631.250 | 514.BE1 | Elevator, bucket, FM#1 | Finish Grind | 60 | 68 |
| 631.255 | 514.BE2 | Elevator, bucket, mill spill, FM#1 | Finish Grind | | |
| 631.270 | 514.BL1 | Blower, airslide, discharge, FM#1 | Finish Grind | | |
| 631.300 | 514.BL2 | Blower, airslide, FM#1 | Finish Grind | | |
| 631.308 | 515.FZ1 | D/C Main fan, mill sweep, FM#1 | Finish Grind | 100 | 150 |
| 631.310 | 515.CQ1 | Cooler, cement, #1, FM#1(SW) | Finish Grind | 50 | 64 |
| 631.320 | 515.CQ2 | Cooler, cement, #2, FM#1(NW) | Finish Grind | 50 | 64 |
| 631.340 | 515.MP1 | Pump, FK, FM#1 | Finish Grind | 125 | 157 |
| 631.350A | 515.CP1 | Compressor, C300, FK pump, FM#1 | Finish Grind | 200 | 270 |
| 631.360 | 510.FZ1 | D/C Main fan, fringe bin, FM | Finish Grind | | |
| 631.405E | 515.SC2 | D/C screw conveyor, (E), FM#1 separator | Finish Grind | | |
| 631.405W | 515.SC3 | D/C screw conveyor, (W), FM#1 separator | Finish Grind | | |
| 631.420 | 515.FZ2 | FM#1 sep D/C fan | Finish Grind | 350 | 47 |
| 631.430 | 515.CP2 | Compressor air, separator D/C, FM#1 | Finish Grind | 30 | 37 |
| 631.520 | 510.CA1 | Crane, bridge, 20 ton, FM | Finish Grind | | |
| 631.530 | 510.CA3 | Crane, ball charging, 5 ton, FM | Finish Grind | | |
| 641.040 | 523.WF3 | Feeder, weigh, gypsum #3A, FM#2 | Finish Grind | | |
| 641.050 | 523.WF4 | Feeder, weigh, clinker silo #4, FM#2 | Finish Grind | 1 | 5 |

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|---|--------------|-------|---------|
| Old | New | | | | |
| 641.060 | 523.WF5 | Feeder, weigh, clinker silo #5, FM#2 | Finish Grind | 1 | 5 |
| 641.070 | 523.FZ1 | D/C Main fan, mill feed, FM#2 | Finish Grind | 10 | 13.4 |
| 641.091 | 523.FZ2 | D/C Main fan, bin vent, FM#2 | Finish Grind | | |
| 641.110 | 523.BC1 | Conveyor belt, mill feed, FM#2 | Finish Grind | 3 | 4.24 |
| 641.130 | 524.PZ1 | Pump trunion lift, input, FM#2 | Finish Grind | 1 | 2 |
| 641.140 | 524.PZ2 | Pump trunion lift, discharge, FM#2 | Finish Grind | 1 | 2 |
| 641.150 | 524.PZ3 | Pump lube, input, FM#2 | Finish Grind | 1 | 2 |
| 641.160 | 524.PZ4 | Pump lube, discharge, FM#2 | Finish Grind | 1 | 2 |
| 641.180 | 524.MA2 | Motor, FM#2 | Finish Grind | 2500 | 277 |
| 641.210 | 524.SC1 | Conveyor screw weighing, FM#2 | Finish Grind | 20 | 25.7 |
| 641.220 | 524.SZ2 | Separator air, FM#2 | Finish Grind | 100 | 115 |
| 641.250 | 524.BE2 | Elevator, bucket, FM#2 | Finish Grind | 60 | 68.5 |
| 641.270 | 524.BL1 | Blower, airstide, discharge, FM#2 | Finish Grind | | |
| 641.300 | 524.BL2 | Blower, airstide, FM#2 | Finish Grind | | |
| 641.302 | 525.SC1 | Conveyor screw, mill sweep, FM#2 | Finish Grind | | |
| 641.308 | 525.FZ1 | D/C Main fan, mill sweep, FM#2 | Finish Grind | 100 | 150 |
| 641.310 | 525.CQ3 | Cooler, cement, #3, FM#2(SE) | Finish Grind | 50 | 64 |
| 641.320 | 525.CQ4 | Cooler, cement, #4, FM#2(NE) | Finish Grind | 50 | 63 |
| 641.340 | 525.MP2 | Pump, FK, FM#2 | Finish Grind | 125 | 151 |
| 641.350A | 525.CP2 | Compressor, C300, FK pump, FM#2 | Finish Grind | 200 | 270 |
| 641.405E | 525.SC2 | D/C screw conveyor, (E), FM#2 separator | Finish Grind | 15 | 19.1 |
| 641.405W | 525.SC3 | D/C screw conveyor, (W), FM#2 separator | Finish Grind | 15 | 19.1 |
| 641.420 | 525.FZ2 | FM#2 sep D/C fan | Finish Grind | 350 | 47 |
| 641.430 | 525.CP1 | Compressor air, separator D/C, FM#2 | Finish Grind | 30 | 37 |
| 651.300 | 510.CA2 | Crane, monorail, FM top | Finish Grind | | |
| 660.101 | 510.FN1 | Fan, roof vent, #1, FM (SW) | Finish Grind | | |
| 660.102 | 510.FN2 | Fan, roof vent, #2, FM (NW) | Finish Grind | | |
| 660.103 | 510.FN3 | Fan, roof vent, #3, FM (SE) | Finish Grind | | |
| 660.104 | 510.FN4 | Fan, roof vent, #4, FM (NE) | Finish Grind | | |
| 660.105 | 510.FN5 | Fan, vent, #1, FM (SW) | Finish Grind | 3 | |
| 660.106 | 510.FN6 | Fan, vent, #1, FM (SW) | Finish Grind | 3 | |
| 661.040 | 510.SJ1 | Pump, Sump, Primary; Finish Mill | Finish Grind | 20 | |
| 661.050 | 510.SJ2 | Pump, Sump, Secondary; Finish Mill | Finish Grind | 20 | |
| 671.250 | 510.VB1 | Shaker, Vacuum system; Finish Mill | Finish Grind | | |
| 671.030 | 510.BL1 | Blower, Vacuum system; Finish Mill | Finish Grind | 15 | 17 |
| | | SUBTOTAL | | 7,294 | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 380 | |
| | | TOTAL | | 7,674 | |
| | | | | | |

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|--|------------|-----|------------|
| Old | New | | | | |
| 681.005 | 515.MP3 | Pump, FK; SST, Railcar Unload | Shipping | | |
| 681.007 | 615.SC3 | Screw Conveyor, Bootlift to FK Pump; SST | Shipping | | |
| 681.031 | 610.FZ1 | Main Fan, D/C; GPII Transfer Bin | Shipping | 10 | 13 |
| 681.033 | 610.FZ2 | Blowback Fan, D/C; GPII Transfer Bin | Shipping | 1.5 | |
| 681.041 | 610.FZ3 | Main Fan, D/C; GPII, Silo 19 (S) | Shipping | 10 | |
| 681.042 | 610.FZ4 | Blowback Fan, D/C; GPII, Silo 19 (S) | Shipping | 1.5 | |
| 681.071 | 610.FZ5 | Main Fan, D/C; GPII, Silo 14 (N) | Shipping | 10 | 13.6 |
| 681.072 | 610.FZ6 | Blowback Fan, D/C; GPII, Silo 14 (N) | Shipping | 1.5 | |
| 682.010 | 613.CP1 | Compressor, Conveying; CYCLONAIRE | Shipping | 800 | 95.3 |
| 682.020 | 613.CP2 | Compressor, Control Air; CYCLONAIRE | Shipping | | |
| 682.030 | 613.BL1 | Blower, Aeration; CYCLONAIRE | Shipping | 1 | |
| 900.141 | 611.SC1 | Conveyor, Screw, Inclined; GPII, Truckside(S) | Shipping | 30 | 38 |
| 900.143 | 611.SC2 | Conveyor, Screw, Inclined; GPII, Truckside(N) | Shipping | 30 | 38 |
| 910.151 | 611.SC3 | Conveyor, Screw, Inclined; GPII, Railside(S) | Shipping | 30 | 38 |
| 910.161 | | Feeder, Vibratory Screen; GP II, Truck Side | Shipping | 5 | 6.5 |
| 910.171 | | Feeder, Vibratory Screen; GP II, Rail/Truck Side | Shipping | 5 | 6.5 |
| 910.153 | 611.SC4 | Conveyor, Screw, Inclined; GPII, Railside(N) | Shipping | 30 | 36 |
| 910.210 | 611.FZ1 | D/C Main Fan; GPII; Truckside Loading Spout | Shipping | 5 | |
| 910.220 | 611.FZ2 | D/C Blowback Fan; GPII; Truckside Loading Spout | Shipping | 3 | |
| 910.310 | 611.FZ3 | D/C Main Fan; GPII; Railside Loading Spout | Shipping | 5 | |
| 910.320 | 611.FZ4 | D/C Blowback Fan; GPII; Railside Loading Spout | Shipping | 3 | |
| 910.710 | 611.CP1 | Compressor, C300; GPII | Shipping | 200 | 270 |
| 910.720 | 611.CP2 | Compressor, C225; GPII | Shipping | 150 | 206 |
| 910.730 | 611.MP1 | Pump, FK; GPII, Transfer System | Shipping | 200 | 223 |
| 910.750 | 611.BZ1 | Blower, Airslide; GPII, Railside | Shipping | 15 | 19.3 |
| 910.751 | 611.BL1 | Blower, Aeration; GPII, Railside | Shipping | 7.5 | 10.7 |
| 910.752 | 611.BL2 | Blower, Aeration; GPII, Truckside | Shipping | 7.5 | 10.7 |
| 910.760 | 611.BZ2 | Blower, Airslide; GPII, Transfer System | Shipping | 10 | 12.9 |
| 920.006 | 611.SJ4 | Pump, Sump; GPI, Freight Elevator | Shipping | | |
| 920.070 | 611.FZ5 | D/C Main Fan; GP1(N) | Shipping | | |

**Attachment B
Motor List**

| Seattle Electrical Motor List | | | | | |
|-------------------------------|---------|---|------------|-------|---------|
| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
| Old | New | | | | |
| 920.071 | 611.FZ6 | D/C Blowback Fan; GPI(N) | Shipping | | |
| 920.080 | 611.FZ7 | D/C Main Fan; GPII, Truckside Loading Spout | Shipping | | |
| 920.081 | 611.FZ8 | D/C Blowback Fan; GPI(S) | Shipping | | |
| 920.604 | 611.BE1 | Elevator, Bucket, FK Pump Feed; GPI | Shipping | | |
| 920.606 | 611.MP2 | Pump, FK; GPI | Shipping | | |
| 920.628 | 611.SC5 | Conveyor, Screw; GPI under silos 3,6,9 | Shipping | 25 | 31 |
| 920.630 | 611.SC6 | Conveyor, Screw, GPI; under Silos 2,5,8 | Shipping | | |
| 920.632 | 611.SC7 | Conveyor, Screw, GPI; under Silos 1,4,7 | Shipping | | |
| 920.633 | 611.SC8 | Conveyor, Screw, GPI, Silo Screws to Elevator | Shipping | | |
| 920.634 | 611.SC9 | Conveyor, Screw; GPI, Rail unload to Elevator | Shipping | | |
| 920.642 | 611.CP3 | Compressor, C250; GPI | Shipping | 150 | 218 |
| 920.685 | 611.BF5 | D/C Main Fan; GPI, Basement | Shipping | | |
| | 611.BL3 | Blower, airslide; SST, railside | Shipping | | |
| | 611.BL4 | Blower, airslide; SST, truckside | Shipping | | |
| | 611.BL5 | Blower, PD | Shipping | 10 | |
| | 611.BZ3 | Blower, Vacuum system; GPII | Shipping | | |
| | 611.CP4 | Compressor, air; Packhouse (E) | Shipping | 20 | 26 |
| | 611.CP5 | Compressor, air; SST | Shipping | 2 | 4.2 |
| | 611.CP6 | Compressor, Primary stage: MODCO | Shipping | 100 | |
| | 611.CP7 | Compressor, Secondary stage: MODCO | Shipping | 100 | |
| | 611.FZ9 | Main Fan; D/C Top, SST | Shipping | | |
| | 611.FZA | Main Fan; D/C, SST Loading | Shipping | | |
| | 611.FZB | Main Fan; D/C; Dome, Top | Shipping | 20 | |
| | 611.HT1 | Hoist, Maintenance Platform, Dome | Shipping | 5 | |
| | 611.HT2 | Hoist, Reclaimer Bridge, Dome | Shipping | 20 | |
| | 611.PZ1 | Pump, Cement MODCO | Shipping | 100 | |
| | 611.LQ1 | Lube System, Reclaim Screw | Shipping | 1 | |
| | 611.LQ2 | Lube System, Rotating Column | Shipping | 1.5 | |
| | 611.RE1 | Column Rotation, Reclaimer | Shipping | 7.5 | |
| | 611.SCA | Screw, Reclaim | Shipping | 100 | |
| | 611.SCB | Screw, Tag | Shipping | 10 | |
| | | Dome tunnel compressor | Shipping | 15 | 18.5 |
| | | SUBTOTAL | | 2,259 | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 200 | |
| | | TOTAL | | 2,459 | |
| | | | | | |

**Attachment B
Motor List**

Seattle Electrical Motor List

| EQUIPMENT # | | Equipment Description | Department | HP | FL Amps |
|-------------|---------|--|------------|-----|------------|
| Old | New | | | | |
| 342.160 | 413.CP1 | Compressor Inst Air, compr room | Utility | 3 | 4 |
| 741.011 | 715.CP1 | Compressor, Plant Air #1; P/H comprm(W) | Utility | 200 | 223 |
| 741.012 | 715.CP2 | Compressor, Plant Air #2; P/H comprm(E,C) | Utility | 200 | 223 |
| 741.013 | 715.CP3 | Compressor, Plant Air #3; P/H comprm(E) | Utility | 200 | 223 |
| 761.010A | 711.FN1 | Fan, Cooling Tower(W) | Utility | 20 | |
| 761.010B | 711.FN2 | Fan, Cooling Tower(C) | Utility | 20 | |
| 761.010C | 711.FN3 | Fan, Cooling Tower(E) | Utility | 20 | |
| 761.021 | 711.WP1 | Pump, Circulating #1; Cooling Water | Utility | 50 | 62 |
| 761.022 | 711.WP2 | Pump, Circulating #2; Cooling Water | Utility | 50 | 62 |
| 761.023 | 711.WP3 | Pump, Water/Oil Separator; Cooling Water | Utility | 5 | 7 |
| 761.024 | 711.SJ1 | Pump, Sump, Main; Preheater | Utility | 10 | |
| 761.025 | 711.SJ2 | Pump, Sump, Aux; Preheater | Utility | 10 | |
| 761.026 | 711.SJ3 | Pump, Sump, Main; Coal Mill | Utility | 1 | |
| 761.027 | 711.SJ4 | Pump, Sump, Aux; Coal Mill | Utility | 1 | |
| 761.028 | 711.SJ5 | Pump, Sump, Main; Burner Bldg | Utility | 0.5 | |
| 761.029 | 711.SJ6 | Pump, Sump, Aux; Burner Bldg | Utility | 0.5 | |
| 761.031 | 711.SJ7 | Pump, Sump, Main; Cooling Water | Utility | 1 | 2 |
| 761.032 | 711.SJ8 | Pump, Sump, Aux; Cooling Water | Utility | 1 | 2 |
| 761.040 | 711.CP1 | Pump, Sump, Aux; Cooling Water System | Utility | 2 | 3 |
| | | SUBTOTAL | | 795 | |
| | | MISSING MOTORS AT ASSUMED 10HP EACH | | 0 | |
| | | TOTAL | | 795 | |

| | | | | | |
|--|--|---------------------------------|--|-----|--|
| | | TOTAL NUMBER OF MOTORS | | 391 | |
| | | NUMBER OF MOTORS W. HP MISSING | | 90 | |
| | | PERCENT OF MOTORS W. HP MISSING | | 23 | |

Audit Schedule

Pre-audit Plant activities:

1. Locate strip chart recorder and ready for use. The recorder will be used to monitor motor amps or power on various plant air compressors. If the plant does not have a strip chart recorder to monitor one will have to be rented by the plant or by Hans Steuch or Ron Vidergar .
2. Identify plant personnel who will be taking part in the audit.
3. Assemble all of the requested information
4. Identify various locations on plant air system that will allow pressure readings to be taken. Plant should make an attachment that will allow for a pressure gauge to be manually attached to various plant air outlets around the plant.

Audit Agenda

Day 1: Compressed Air

1. Discuss Audit with plant personnel.
2. Review data available, determine what information is not available.
3. Start 6 hour compressor amp monitoring with chart recorder.
4. Review compressed air system information available. Review compressed air system loads
5. Review all fans in plant..Are dampers 100% open? Review fan curves.
6. Walk the plant, reviewing the compressed air system, looking for leaks etc.

Day 2: Electrical Motors

1. Review motor list information
2. Determine if Power company has any energy savings programs available
3. Evaluate motor utilization. Are there any opportunities to reduce power consumption?
4. Walk the plant, reviewing electrical motors, plant equipment.
5. Summarize info collected and observations. Assign any further data collection tasks.

Seattle 4/4 - 4/6/00

Attachment C Audit Schedule and Task List

2000 PEP Audit Task List

"Peak shaving strategies not
economically justified."
✓ Power contract not negotiated.

Compressed Air Systems:

1. Develop an accurate compressed air piping diagram. ✓
 - a. include compressor information ✓
 - b. include header pipe sizes ✓
 - c. included compressor motor information ✓
4. Tabulate the theoretical compressed air requirement by department:
 - a. baghouses
 - b. dust collectors
 - c. diverter gates
 - d. conditioning towers
 - e. air blasters
 - f. fuel valve trains
 - g. analyzer systems

Handwritten calculations:
Blasters (200) + Blowers (200) +
Sizing (50) + 80 Blm (conditioning system) (50) + small lines (348)
23 - 0.01 + large lines (248 / 376 * 1.0 * 3) = 1230.5
Actual: (1 + 0.6) * 755 = 1208
8. Compare the theoretical requirement with the actual demand
9. Any signs of air leaks? *Yes, simulated*
10. Measure air pressure at various locations in plant.
11. Evaluate ability to measure compressed air flow in system
12. What air pulse cycles are being used on plant dust collectors.
 - a. can cycle time be slowed?
7. Estimate \$/year for compressed air

Electrical Systems:

1. Review Motor List.
 - a. Look for opportunities to reduce power by operational philosophy
 - b. Determine which motors will be monitored. (FK pumps and compressors, Homo systems, airlift blower motors, large elevators, large fans, water well pumps, belt conveyors, dust collector fans etc)
3. Look for motor applications where the motor seems oversized for the application
4. Review Fan operation. *RM fan is perhaps RM screw, main baghouse reverse air*
 - a. Are dampers 100% open?
 - b. Is operation in the optimum part of the fan curve
 - c. Can Everage be of any service?
4. Do power suppliers have any power savings programs that we can take advantage of? *Yes, 1998 study*
- 5. Review completeness of motor list
- ? 6. Review screw conveyor operation.
 - a. Could the operation of these conveyors be cycled on and off? (ESP conveyors for example, especially the last sections)
7. 2. Review Belt conveyor operation. *Some work already done on spurs*
 - a. How much time is spent with the conveyor operating empty before or after the production day is complete. Is this weather related?
2. Review Dust Collector fan damper operating positions
3. Review reverse air fan damper operating positions
4. Review pneumatic conveying systems.
 - a. Do motor HP for pump and/or compressor match application as compared to similar systems in other Ash Grove plants?
 - b. What motor loads are typical while in operation? How does this compare with motor nameplate?
3. Review Homogenization Silo operation and equipment sizing
 - a. Is equipment motor sizing similar to other Ash Grove Cement facilities
 - b. Has plant modifications over time increased motor HP over initial design
 - c. What motor loads are typical while in operation? How do these compare with motor nameplate?